

## MELTING PLATE CANDLES

### RELATED APPLICATION

- 5 This is a Continuation-In-Part application of Serial Number 09/468,970, filed December 21, 1999.

### FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

- 10 Not Applicable.

### BACKGROUND OF THE INVENTION

#### Technical Field

- 15 The present invention relates to means to provide a novel fuel burning element, such as a candle or lamp, which consumes fuel more efficiently while presenting an aesthetically pleasing appearance. The candles or lamps of the present invention comprise a solid fuel element, a consumable wick, and heat conductive means to transfer heat from the burning fuel, i.e. the flame, to the re-
- 20 maining fuel, thereby assuring its more rapid and complete melting and uniformity of temperature.

#### Background Art

- 25 Ordinary candles comprise a vertical, self-supporting body or column of wax, with a substantially horizontal top and a central longitudinal wick which extends through and above the wax. The exposed portion of the wick above the solid wax is lighted by a flame, and the heat generated by the lighted wick melts a small volume of the wax at the top of the candle, proximate the wick, establishing a puddle or reservoir of molten wax to serve as fuel for the flame on the
- 30 wick. The capillary attraction of the molten wax and the wick, which is generally a structure of closely related fibers, causes the molten wax to travel through the

wick to the flame, by which it is consumed. As the wax is consumed in this manner, the body of wax diminishes and the top surface thereof progressively lowers. The upper portion of the wick, extending above the lowering wax, is generally consumed by the flame.

5 Also well known are such candles or lights as tea lights, in which a body of paraffin is located in a container having a wick centrally disposed. At the lower end of the wick is a wick holder or wick clip, which functions to retain the wick in its perpendicular position, even as the paraffin is melted and liquified by the heat of the flame. In most such candles, the wick is a cotton material saturated with  
10 the paraffin, and burns with the paraffin, thus being consumable. In such candles, or lights or warmers employing the same, the visible flame diminishes as the wick is consumed, the container becomes hazardously over-heated by the flame, and the unit is time-limited by the volume of paraffin and size of the wick initially present. Further, after consumption of all of the wax in the unit, the con-  
15 tainer and the wick holder remain to be disposed of by the consumer.

Similarly, liquid fuel lamps are known in which a wick is supported with one end suspended in a reservoir of liquid fuel, such as lamp oil. By capillary action, the liquid fuel rises through the wick to the upper end thereof, where it is subjected to consumption by a flame. As fuel is consumed by the flame, addi-  
20 tional fuel rises through the wick by capillary action to feed and maintain the flame. Permanent, or non-consumable, wicks are most frequently employed for this type of lamp.

In U. S. Patent No. 4,557,687, Schirneker teaches a fuel element comprising a shell-like elongated housing in which a supply of fuel may be placed,  
25 with a wick immersed in the fuel supply with its upper portion protruding from the top of the housing. When the fuel is a solid fuel, such as paraffin, the wicks must conduct heat into the housing of the fuel in the area of the immersed wicks so as to provide sufficient amounts of molten paraffin to be drawn up in the wick. Such conductivity may be obtained by means of a piece of metal embedded in the  
30 wick. The purpose of the fuel element is to provide a simulated log for a fireplace which does not require a chimney.

In U. S. Patent No. 3,741,711, Bryant teaches a composite decorative candle formed of clear, undyed and unpigmented candle wax in any appropriate candle shape, provided with a centrally recessed glass cylinder into which a replaceable small candle may be placed. Thus, the decorative outer candle may have a refill unit, such as a votive or tea light, placed therein to provide indefinite reusability. If the outer candle body comprises surface ornamentation, a luminescent glow through the candle body results when the inner candle is burned, and the outer candle is not consumed.

U.S. Patent 3,910,753, of Lee, discloses a wax burner comprising a vessel having a heat conducting metal heat sink surrounding and supporting a wick which projects upwardly, and has a heat conductive metal core means conducting heat into the heat sink, which acts as a wax melting surface. The wax burner may be fueled by paraffin wax or other suitable solid fuel, which may be added to the melting surface as required. The burner may constitute one or more burner units. In Lee, however, the fuel is neither supported nor contained by the heat sink, which is configured much like a spool, with upper and lower flanges, or upper and lower flat, horizontal surfaces. The upper flange or upper surface acts as a heating surface, while the lower flange serves as a base for the heat sink, engaging the bottom surface of the burner vessel. Slots in the vertical surface of the heat sink provide means for the wax, melted by the heat sink, to flow from the exterior surface thereof to the internally located wick. Since the wick structure of the patent includes a metal core and a heat conductive metal sleeve about the wick, the wick structure is an integral portion of the heat sink of the burner assembly, and is non-consumable, and requires priming with wax prior to its first use. In use, solid wax is added to the heating surface, and replenished as necessary, or the entire vessel may be filled with wax. It is to be noted that the vessel itself is not used to conduct heat to the fuel, but only to contain it, and that a separate heat transfer system, i.e. the heat sink structure, which is independent of and distinct from the heat radiated by the flame itself, is utilized to achieve burning of the wax fuel. Even with this added heat transfer mechanism to assist in melting of the fuel, complete utilization of all of the fuel in the vessel is una-

chievable, even when the burner is permitted to burn to self-extinguishing, in view of the relative positioning of the lower flange and the wax conducting means of the heat sink (i.e. slots in the vertical surface thereof, above the lower flange).

In U.S. Patent No. 2,713,256, Oesterle et al teach a votive candle having  
5 a wick extending downward in the bottom of the candle into a tapered central body projection, where said wick engages an adapter inserted into the cup for the votive. The adapter is provided with means to support the wick of the candle until the candle has completely burnt out, thereby leaving no wax or wick residue in the cup, enabling a new candle to be inserted into the cup without removal of  
10 the adapter. The adapter does not function to provide a more even or uniform burning of the candle, but to provide a proper positioning of the votive candle. When placed over the adapter, and the upwardly directed tube thereof, the flame on the wick comes into contact with a wicking material retained in the base of the tube, so as to ignite such wicking and assure that all of the melted wax is burned,  
15 thus leaving a clean cup containing no remains of the previous candle when a new candle is put in place.

European Patent Application EP 1 054 054 A1, published November 22, 2000, teaches a candle having a wick clip assembly for candles to be used on a supporting surface, wherein the wick clip provides enhanced control over heat  
20 transfer from the flame to the supporting surface upon which the candle rests. In this patent, the object of the wick clip assembly is to dissipate heat from the flame away from the support surface, essentially the opposite of the goal of the present invention.

A number of additional patents teach the use of heat conductive elements  
25 to liquify solid fuel for consumption at a wick, or to dispense an element such as a fragrance or insect control material. These include U. S. Patents 5,078,591 of Despres; 4,755,135 of Kwok; and 5,425,633 of Cole; as well as PCT Application WO 89/06141, assigned to Lamplight Farms, Inc.

None of the foregoing references, however, provide a long burning candle  
30 or lamp device capable of rapidly and completely melting a solid fuel and ensuring efficient and complete utilization of all of the fuel provided, while providing in-

creased safety and convenient refilling. Further, the concept of the present invention offers highly decorative as well as functional candles and lamps, which may utilize a variety of gel and solid fuels, with the significant advantages of permitting rapid and convenient replacement of one fuel element by another at the whim of the consumer.

## BRIEF SUMMARY OF THE INVENTION

As utilized herein, the term melting plate candle shall encompass the combination of a solid fuel element, and a container or holder for the fuel. On the other hand, the terms fuel container and fuel holder shall be meant to encompass a melting plate comprising means to contain, support and melt the fuel element, a wick affixed to said melting plate, and heat conductive elements to transfer heat from a flame upon said wick to said melting plate. Thus, it may be seen that the melting plate functions to hold the fuel element, while also serving to retain the wick and to conduct heat to the solid fuel element to thereby melt said fuel to provide a liquid fuel to feed to the flame via the wick. Accordingly, the manufacturer may provide melting plate devices and solid fuel elements independently or separately, and the consumer may join the two to form a melting plate candle or fuel burner, with the option to change fuel elements at will.

The present invention provides a means for the burning of solid fuel elements, wherein said means ensures the maximum utilization of the solid fuel provided. The melting plate devices of the present invention comprise a container for gel or solid fuels, and a wick, and provide an improved transfer of heat from a heat source, a flame burning the fuel at the wick, to the remaining fuel and, more importantly, back to the container for said fuel. Such devices are preferably both functional and designed so as to be decorative or esthetically pleasing.

The melting plate candle of the present invention comprises a fuel element, a container for the fuel, which container comprises a heat conductive heat plate, or melting plate, in direct contact, and in supporting or containing relationship, with the fuel element. The melting plate candle of the present invention

may further comprise heat conductive elements to transfer heat by conductive means to the fuel and to the melting plate, in addition to that heat transfer obtained by radiation from the flame. Such conductive elements result in improved transfer of heat from the burning wick to both the fuel and the melting plate, with which the fuel is in contact, thereby heating the fuel over a relatively large surface. This, in turn, provides for rapid melting of solid and gel fuels, and rapid heating of the thus melted fuels, to provide a more uniformly heated pool of fuel. Since a goal of the present invention is to more rapidly heat the fuel to temperatures which are not readily achieved by a conventional candle or lamp, so as to more fully melt the solid fuel and to improve consumption of the fuel, the heating plate element shall hereinafter be referred to as a melting plate.

The melting plate, which acts both as a fuel container and a heat transfer means to heat the fuel, is shaped so as to collect the melted or liquified fuel at its lowest point, at which point a wick is located, so as to ensure that all fuel is fed to the wick, whereby the maximum consumption of the fuel is achieved. Thus, the melting plate is preferably shaped as a bowl, or in the form of a funnel, with the lowest portion thereof preferably, but not necessarily centered. The wick is located so as to be at the lowest portion of the melting plate, and may be positioned in a complementary depression in the fuel container or melting plate. The entire interior surface of the fuel container is preferably highly heat conductive, and supports, contains, and heats the fuel, although containers in which only a small portion of the interior surface acts as a melting plate are within the scope of the present invention. The heat conductive surfaces of such containers shall be referred to as the melting plate, and candles employing such melting plates shall be referred to, collectively, as melting plate candles. In the preferred embodiments, the melting plate shall comprise the entire fuel container.

Moreover, the melting plate helps to control the shape and depth of the pool of fuel which is burned at the wick, and to maintain the constancy thereof. It is to be understood that the fuel utilized in the present invention may be initially in solid or gel form, but must be in liquid form for moving up the wick by capillary action to the flame, where it is consumed. Thus, the fuel used with the melting

plate candle shall be such that it will not be transported by capillary action at ambient or room temperature, but requires heating to a liquified state, i.e. melting, to be subject to wicking action. For convenience, the term solid fuel shall be used hereinafter to refer to fuel in either a gel or conventional solid state, such as conventional candle wax. It is also to be understood that the fuel consumed in the flame at the burning wick is drawn by the wick from a liquid pool of fuel, which pool is formed by melting of the solid fuel, said liquid pool being heated by conductive heat transfer by the melting plate, the wick, and heat exchange elements, in addition to the radiant heat from the flame on the wick. By the use of the melting plate technology of the present invention, in addition to the conventional radiant heating of the surface of the fuel, the size and temperature of the liquid pool of fuel are better regulated, and as a result of greater heat transfer to the fuel, a melted, liquid pool thereof is more rapidly formed and heated to a relatively high temperature, and efficiency of consumption thereof is improved. Because the speed of achieving a liquid pool of fuel is increased, a more efficient consumption of the fuel results, as well as a more complete usage of available fuel, due to the decrease of fuel left unburned on the surface of the melting plate. In preferred embodiments of the present invention, a pool of liquid, i.e. melted, fuel rests upon the surface of the heat conductive melting plate. This pool of fuel may contain unmelted fuel in the solid state, as well as melted fuel.

Generally, the melting plate device embodies both a melting plate and a heat conductive element, which element is in close proximity to the flame, to ensure more uniform and rapid heat distribution from the flame upon the wick. The wick is affixed in its preferred position by means of crimping to a wick clip, press fit, or by other appropriate conventional means, such as by welding, soldering, or cementing, as with an adhesive. The wick may be any filamentary body which is sufficiently sturdy, which will burn with a steady flame, and which is capable of drawing up the molten candle fuel by capillary action. Such a wick may be of any conventional consumable wick material, such as cotton, cellulose, nylon, or paper. The wick may preferably be located in the center of the candle, or may be

off-center as desired. The presence of two or more wicks is also within the scope of the present invention.

The heat conductive element may constitute a portion of the melting plate itself, formed or bent to be in proximity to the flame, or may be a separate assembly which is utilized in conjunction with the melting plate and consumable wick. For example, the melting plate may constitute a bowl shaped container having its outer periphery in close proximity to the flame, such as a container in which the upper lip of the bowl is formed so as to curve back toward the center of the bowl. Alternatively, the melting plate may have one or more raised portions, or lobes, which may act not only to absorb and distribute heat by conduction, but to channel or direct the flow of liquid fuel to the wick, and/or to engage the fuel element in such a manner as to properly position it. Further, the lobes may constitute areas of higher heat conductivity than surrounding areas of the container.

However, as indicated, the heat conductive element may also be a separate and independent assembly, including means to support and locate the wick, which assembly may be replaced as necessary or desired, but is preferably a permanent feature of the melting plate. The heat conductive element assembly may take the form of heat fins or heat conductive surfaces having either vertical or horizontal orientation, or elements of both. In preferred embodiments, such heat conductive elements are heated by contact with the flame, or by radiation of heat from the flame, and conduct such heat to the melting plate and to the fuel so as to more efficiently heat the fuel.

It is to be understood that the heat conductive elements may be so situated and shaped as to engage or interlock with a replaceable or refillable solid fuel element, such as being of a specific shape or configuration that will engage or mate with a complementarily shaped fuel element. In a similar fashion, the heat conductive elements and/or the fuel container may be formed in such a manner as to permit placement of fuel elements of specific configuration, such as balls, cylinders, or cubes, for example, in a preferred position in proximity to the heat conductive elements themselves, or to the wick, in such a manner as to maximize heat transfer to said fuel elements.



The present invention is thus a melting plate candle, said melting plate candle comprising, in its most basic form, a container, and a solid fuel element having a consumable wick, wherein said container is configured so as to cause the flow of liquid fuel to the wick, at which wick the fuel may be burned to produce heat so as to liquify said solid fuel element. In a preferred embodiment, the melting plate constitutes a container comprising a melting plate configured so as to cause the flow of liquid fuel to the wick, a consumable wick, and a heat conductive element to conduct heat from a flame at the wick to the melting plate, which is in contact with a solid fuel element. In such a preferred embodiment, the fuel is a solid wax, which is melted by heat conducted via the heat conductive element and the melting plate, to provide liquid fuel to the flame via the wick.

In one aspect, the invention provides a method for fueling a long-burning melting plate device, wherein replenishment fuel is added as necessary or desired, without the need to extinguish the flame while additional fuel is provided. By use of a conductive melting plate, the solid fuel is heated over a relatively large surface area, to speed the melting and heating of a large volume of solid wax or fuel. The liquid pool of wax or fuel thus formed acts both as a reservoir and a safety feature, since such a pool will act to extinguish a flame at the wick if the pool level becomes excessive, or if the device is tilted excessively, particularly as the melting plate is so configured as to cause liquid fuel to flow to the wick.

The objects of the present invention therefore include providing melting plate candles and lamps, which are:

- (a) capable of burning for extended periods without close attention;
- (b) capable of burning a variety of fuels which may be conveniently and rapidly changed or added as desired;
- (c) able to rapidly produce a pool of melted wax for consumption at the wick;
- (d) highly decorative;
- (h) self cleansing, in the sense that they leave little or no residue of unburned fuels; and
- (i) relatively inexpensive to produce, and economical for the consumer.

The use of the melting plate technology of the present invention may also provide such advantages as elimination of tunneling, significant reduction of retention of wax at the conclusion of the burn, elimination of walking or off-center wicks, while also giving a large pool of liquid wax with a relatively small flame in a relatively short time period. In addition, the container may be of almost any shape desired, providing for great aesthetic possibilities. Since the fuel element is provided as a separate unit, the consumer may be provided a great number of choices as to the color and nature of the fuel, and the configuration of the fuel element may be varied to provide a large choice of shapes, such as seasonably decorative items. For example, shapes such as pumpkins may be provided for Halloween, and wreaths for Christmas. In addition, the fuel element may be so configured as to cooperatively engage the melting plate and/or the heat conductive element, in such a manner as to provide the consumer the greatest degree of ease in placement of the fuel element in optimal position in the melting plate candle, with the least possibility of incorrect placement.

Thus, an object of the present invention is to provide a lamp or candle device, said device comprising, in combination, a fuel element comprising a solid fuel, a container for said fuel element, and, a wick at which said fuel may be burned to produce heat so as to melt said solid fuel, wherein said container is configured so as to cause the flow of melted fuel to said wick.

Accordingly, it is an object of the present invention to provide a melting plate candle, wherein said candle comprises a container for a fuel element comprising a fuel selected from the group consisting of paraffin, beeswax, montan wax, carnauba wax, microcrystalline wax, stearic acid, fatty alcohols, fatty acids, fatty esters, and gels incorporating such fuels, in a form selected from the group consisting of pucks, donuts, chips, slivers, balls, pellets, shavings, particulates, cubes, discs, three dimensional shapes, and wafers, or in any other suitable shape, wherein said container is a concave melting plate further comprising a consumable wick and a heat conductive element chosen from the group consist-

ing of lobes, fins, wick holders, and combinations thereof, and said heat conductive element cooperatively engages said fuel element.

Similarly, a further object of the present invention is to provide a melting plate candle or lamp, said candle comprising, in combination, a meltable solid fuel, a consumable wick, a conductive base upon which said fuel rests, and heat conductive elements by which heat is conducted to said base from a flame upon said wick, whereby a pool of heated liquid fuel is created, wherein said heat conductive base is configured so as to cause the flow of said heated liquid fuel to said wick for combustion, and said base and said elements are configured so as to cooperatively engage said fuel.

Accordingly, an object of the present invention includes providing a melting plate candle comprising a solid or gel fuel, which fuel is melted by a heat conductive element selected from lobes, fins, wick holders, or combinations thereof, said heat conductive element being heated by a flame at a wick, a heat conductive base upon which the fuel rests, the base being configured so as to cause the flow of melted fuel to the wick, and the heat conductive element configured to cooperatively engage the fuel element.

A further object is to provide a melting plate lamp or candle comprising a replaceable fuel element, and a fuel containing device comprising a heat conductive melting plate, a wick, and a heat conductive element to collect heat from a flame at said wick and conduct said heat to said melting plate to thereby melt said fuel and form a pool of liquid fuel on the surface of said melting plate, wherein said containing device is configured to position and engage said fuel on said melting plate for rapid melting, and said melting plate is shaped so as to cause said pool of liquid fuel to flow to said wick.

Also desired is a solid replacement element for a lamp or candle, said element comprising a solid fuel having a consumable wick element. Applicants further teach a device comprising a heat conductive container having affixed thereto a wick, said container configured so as to cause the flow of liquid contents to the wick and to engage and melt a solid fuel element.

These and still other objects and advantages of the present invention will be apparent from the description which follows. The following description is merely of the preferred embodiments, and the claims should be looked to in order to understand the full scope of the invention.

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## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the basic concept of the melting plate candle, in simplified perspective view.

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Figure 2 illustrates a basic melting plate candle of the present invention, in simplified cross section.

Figures 3a through 3e are perspective views of various exemplary heat conductive elements in the form of wick holders, and fins, which are suitable for use in this invention.

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Figures 4, and 5 are cross sectional representations of melting plate candles employing melting plates of differing configuration.

Figures 6 and 7 are a top view and a perspective view of an oval melting plate candle employing heat lobes in the form of raised portions of the melting plate.

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Figure 8 illustrates a perspective view of a melting plate candle employing a wick, and a refill fuel element in the form of a wax ball positioned adjacent the wick by heat lobes formed as part of the melting plate.

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Figure 9 is a simplified cross sectional view of a floating melting plate candle, comprising a melting plate, heat conductive element in the form of a wick holder having fins, and a solid wax refill segment.

## DETAILED DESCRIPTION OF THE INVENTION

Figures 1 and 2 illustrate the concept of the melting plate candle in its most basic form. As illustrated, a heat conductive bowl shaped melting plate, 2, is provided, which transfers heat from the heat source, a flame (not shown) lo-

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cated on wick 3, by means of heat conduction, to a solid fuel element, 4, which rests upon the surface of the melting plate. For purposes of illustration, and for clarity, but intending no limitation, the wick is illustrated as being of a relatively large diameter, rather than as a conventional fibrous consumable wick of small diameter. It is to be understood that the wick is conventionally positioned and attached to and within the solid fuel element, 4, such as with a wick clip (not shown). The melting plate, 2, is heated directly by the flame on the wick, 3, either by direct contact therewith, or by radiation, as in Figure 1 and 2, as a result of the melting plate being shaped so as to have a portion in proximity to the flame, the diameter of the melting plate bowl being such as to permit the inner surfaces thereof to absorb appreciable amounts of heat from the flame.

In a melting plate candle apparatus, the wick may be held by a conventional wick clip, or may be held in place by a heat conductive element, such as a wick holder, as shown in Figure 4, or affixed to or retained by the fuel element by other appropriate means. To assure efficient heat exchange between the flame at the wick and the melting plate, the melting plate of Figures 1 and 2 is shaped so as to have a portion, in this case a raised shoulder, 22, of the melting plate, which is in proximity to, and heated by, the flame of the burning wick, which results in heat being transferred rapidly to the fuel by both conduction through the melting plate and by radiation from the flame. The solid fuel element is subject to melting from heat from the flame and the melting plate. As opposed to a conventional candle, transfer of heat from the flame to the fuel with a melting plate device is primarily by conduction, either through the melting plate or through additional heat conductive means, rather than by radiation, and is thus considerably more efficient, resulting in more rapid and more uniform melting of solid fuel and formation of a pool of liquid fuel, a more efficient burn, and easier lighting. However, difficulty in lighting the wick may be encountered. For this reason, a starter bump, 6, of fuel, is provided in close proximity to the surface of the wick. As illustrated, this bump is most easily molded directly into the shape of the fuel element, and provides a ready source of liquid fuel to the wick when a match or

other appropriate source of flame is employed to start the wick burning, which source of flame will melt the starting bump.

The melting plate of Figures 1 and 2 is shaped so as to have a raised outer shoulder, 22, thereby containing the resultant pool of melted fuel. It is to be understood that the melting plate may be in the form of a tray, bowl, concave plate, or other configuration which is capable of holding a pool of hot liquid fuel, and is so shaped as to funnel or channel the liquified, i.e. melted, fuel to the wick. The bowl shape of Figures 1 and 2 is a preferred embodiment. The melting plate may constitute a container in itself, as shown, or may also be surrounded by a separate container, as illustrated in Figures 5 through 9, hereinafter. In the embodiment shown in Figures 1 and 2, the melting plate rests upon a non-conductive base, 17, or legs of non-conductive or insulating material, so as to permit placement upon a table, counter, or other surface. The non-conductive base, as illustrated, comprises contact points, 25, so as to minimize the amount of contact between the base and the melting plate, and to create an insulating air gap, 27, between the melting plate and the surface upon which the assembly rests.

The melting plate may be of any heat conductive material, such as brass, aluminum, steel, copper, stainless steel, silver, tin, bronze, zinc, iron, clad materials, heat conductive polymers, ceramics, glass, or any other suitable heat conductive material or combination of such materials. As shown in Figure 2, the fuel is preferably located in direct contact with the surface of the melting plate, 2, which plate may, if desired, be constructed so as to have a non-conductive lower surface, so that the melting plate may rest upon a table surface or such. Such a configuration may result from a clad material, a conductive material coated with a non-conductive material, a non-conductive material having an insert of a heat conductive material, or other suitable arrangements to permit the melting plate to be cool enough on the bottom surface to permit ease of handling, and/or placement upon surfaces not suitable for contact with heated bodies, and as shown in Figure 5, for example.

The wick, 3, preferably constitutes a conventional wicking material, such as such as cotton, cellulose, nylon, or paper, or a porous ceramic, fiber glass, or pumice wick, or the like, which by capillary action will carry liquid fuel to the flame. Suitable permanent or non-consumable wicks may comprise such materials as porous ceramics; porous metals; fiber glass; metal fiber; compressed sand, glass, metal, or ceramic microspheres; foamed or porous glass, either natural or man-made, such as pumice or perlite; gypsum; and chalk. In addition, non-combustible materials such as metal may be used to create capillary grooves, spaces, or tubes in or between closely spaced sheets. However, for purposes of the present invention, the use of conventional consumable wicks is preferred. The wick, 3, may be located in the center of the melting plate, 2, or may be off-center as desired, provided that the melting plate is configured so as to channel or funnel the melted fuel to said wick. The presence of two or more wicks is also within the scope of the present invention, as is the use of wicks which are provided as part of the melting plate assembly, a wick holding heat fin assembly, or as part of a removable separate heat clip or wick holder. When provided as an element of the melting plate, the wick may be attached to, adhered to, or incorporated in any manner which does not inhibit the capillary action of the wick in feeding liquid fuel to the flame.

The fuel may be a solid fuel which is liquified, i.e. melted, before or during consumption, such as any conventional candle wax, such as petrolatum or a micro wax, including paraffin, beeswax, montan wax, carnauba wax, microcrystalline wax, stearic acid, fatty alcohols, fatty acids, fatty esters, or the like, or gels incorporating such fuels, having melting temperatures above ambient, but below the flame temperature of a wick burning such fuel. Such solid fuel may be colored for decorative effect, if so desired, and may be shaped to fit any given configuration of melting plate. For example, the bottom of a solid fuel element should be curved complementarily to the shape of the melting plate upon which it is to rest. Further, the solid fuel may take the form of wax pucks, donuts, chips, slivers, balls, pellets, shavings, particulates, cubes, discs, three dimensional shapes, and wafers, or the like, in sizes suitable for ease of addition to the melting plate or

fuel pool. The solid fuel element may further contain actives such as fragrances, herbals, disinfectants, air purifiers, insecticides, or insect repellents, to be evaporated from the fuel pool as a result of the temperature of said pool being elevated above the melting temperature of the solid fuel by the melting plate and heat  
5 conductive elements.

An important aspect of the present invention is the additional use of a heat conductive element in conjunction with the melting plate, or as part of the melting plate. In addition to taking the form of a heat conductive lobe in or on the surface of the melting plate, the heat conductive element may take the form of a portion  
10 of a heat conductive wick holder which aids in positioning of the wick, or may be present merely as a heat fin, to aid in heat distribution by the conduction of heat from the flame to the fuel. Such heat conductive elements may take a variety of shapes, as exemplified by Figures 3a through 3g, which illustrate various suitable heat conductive elements, but clearly do not illustrate all possible configurations.  
15 The heat conductive element may support or hold the wick, as in Figures 3b, 3e, 3f, and 3g, or may merely pass through the flame or be concentric thereabout without contacting the wick, as in Figures 3a, 3c, and 3d, so as to collect the greatest amount of heat possible from the flame. Shown in conjunction with a wick, the heat conductive element is designed to be in close proximity to, or in  
20 direct contact with, a flame upon said wick, so as to provide a heat collection and distribution member. In these drawings, the wick, 3, is in heat exchange proximity to various forms of heat conductive elements or fins, which act as heat distribution means. The distance of the heat conductive element from the flame should be controlled so as to achieve a suitable degree of heat exchange, i.e. the  
25 heat fin should be less distant from the flame than that distance at which radiant heat from the flame would exceed the amount of heat collected and conducted by the heat fin to the fuel or the melting plate. Due to the variable heat conductivity of materials suitable for use in heat conductive elements, it is not feasible to designate a specific distance between the flame and the heat conductive ele-  
30 ment or fin, but it is clear that the greatest conductive heat transfer to the fuel and the melting plate occurs when a highly conductive heat fin passes directly



through the hottest portion of the flame, and that the amount of heat transferred to a heat conductive element or heat fin decreases as the distance from the flame increases. The heat collected from the flame by the heat conductive element, or heat fin, is transferred directly, by conduction, to fuel which is in contact  
5 with the heat fin, or to the melting plate, and thence to fuel which is in contact with the melting plate. The rate of heat flow by conduction greatly exceeds the rate of heat transfer resulting from the radiant heat generated at the flame, resulting in a more efficient use thereof. Thus, the fuel element is melted more rapidly, and the melted fuel is heated to a greater extent, than it would be absent  
10 the heat conductive elements.

In Figure 3a, a helical wire, 8, surrounds the wick, (again, not drawn to scale) 3, and the flame (not shown) which rises therefrom during consumption of the fuel. The helical wire which, with its heat conductive mounting means, 10,  
15 comprises a form of heat fin assembly, 9, may be directly encompassed by a solid fuel element, or mounted upon or into a melting plate, in such a manner that conductive heat transfer loss is minimized. The helical wire is in close proximity to the wick and thus the flame, but may also pass directly through the flame for greater heat transfer. The heat which is collected by the helical wire passes directly, by conduction, to the melting plate 2, via mounting means 10, and to any  
20 fuel which is in contact with the helical wire fin.

Figure 3b illustrates a heat conductive wick holder, 7, in which a wick, 3, is held by mounting means, 10, to project a short distance above the wings or fins, 11, of the holder. The fins, 11, preferably are fashioned of a highly heat conductive metal. The conductive wick holder, 7, comprising the wick mounting means,  
25 10, and the fins, 11, may provide positioning means, 12, designed to engage corresponding recesses or positioning elements within the solid fuel element, or in the melting plate (not shown).

Similarly, Figure 3c illustrates a heat fin assembly, 9, comprising a circular heat fin, 14, surrounding the wick, 3, and having perforations, 15, or holes therein  
30 to permit flow of air and liquid fuel from the outermost side thereof to the innermost side thereof to fuel the burning of the fuel at the wick, 3. The metallic fin,

14, may also comprise a metal mesh, rather than a perforated metal foil as illustrated. This type of heat fin may also be directly attached to the melting plate, or may incorporate a wick clip, 10, by means of which the heat fin may be incorporated within a solid fuel element. It may be seen that the heat fin is so positioned, surrounding the wick and in close proximity thereto, so as to receive heat by radiation from the flame on the wick, which heat is then transmitted by conduction to the melting plate.

Figure 3d illustrates a heat fin assembly, 9, having a clip mounting means, 10, suitable for inclusion in a solid fuel element, and having fins, 11, parallel to the wick itself. Such a heat fin assembly is particularly suitable for use in a melting plate as shown in Figure 4.

Figure 3e shows a heat fin assembly comprising a wick holder, 7, and a single fin, 11, configured so as to pass through the flame above the wick, 3, in such a manner as to collect and distribute the maximum amount of heat available. In this configuration of wick holder, the wick is positioned by mounting means 28, e.g. a clamp or encircling ring, while the holder may be positioned in place in a solid fuel element during preparation thereof by means of positioning means 12, or other suitable means.

It is to be emphasized that the heat generated at the flame is conducted by means of heat conductive elements to both the melting plate and to the solid fuel, causing it to liquify or melt, thus providing a pool of liquid fuel, 5, as shown in Figures 4 and 5, which is available to the wick to support further combustion. As illustrated in Figures 1 and 2, the solid fuel is located above and in direct contact with the melting plate, which also serves to contain the solid fuel and the liquid fuel derived therefrom by the melting thereof. The direct contact of the melting plate and the solid fuel improves heat flow to the fuel, ensuring a more rapid and complete melting thereof. As the fuel is consumed by the flame, additional melted fuel will be channeled or funneled to the wick as a result of the shape of the melting plate being designed to accomplish such flow. Additional fuel elements may be introduced as desired or necessary, to replenish those which are consumed, or if desired, to change or modify the fuel being consumed.

One preferred embodiment of the use of the melting plate technology of this invention may be referred to as a melting plate candle, 18, as illustrated, for example, in Figures 4 and 5. Figure 4 shows a one piece construction, favorable for low cost production, which uses a wick holder, 7, having fins 11, and in which the entire remaining assembly may be considered to constitute a melting plate. As shown, the melting plate, 2, is shaped so as to provide a bowl shaped container, 20, having a central depression, 16, for placement of a fuel element incorporating a heat conductive wick holder, 7. In a melting plate candle produced in this form, the wick holder, 7, functioned both to position the wick, 3, and to transmit heat, via fins 11, from the flame, 1, to the fuel as well as to the melting plate, 2, which constituted the container for the pool of melted wax, 5. For this illustration, the solid fuel element is not shown, but the fuel is shown as having been completely melted, at which point the wick is supported in position by the wick holder, 7. The wax pool was formed by the melting of a solid fuel element, such as paraffin, which was placed in the bowl shaped container, 20, and melted by heat conducted from the flame by the fins to the melting plate, 2. The height of the raised shoulder, 22, of the bowl shaped container was chosen so as to provide a pool of adequate depth to contain a sufficient supply of fuel to burn for a desired period of time. By use of a highly heat conductive metal, such as aluminum or copper, for the melting plate, and proper dimensioning of the unit, the entire mass of the solid fuel element added to the bowl was rapidly melted from the bottom, resulting in a pool of fuel, 5, which filled the bowl sufficiently to ensure a lengthy burn time. As the level of the pool dropped, additional wax, in the form of chips, shavings, granules, cubes, or small balls, was added, and rapidly melted. It is to be noted that while the melting plate candle, 18, illustrated by Figure 4 was essentially circular, the shape is not critical, and may be varied, such as in the form of a square, triangle, oval, rectangle, clover, diamond, etc, provided that it is shaped so as to channel the liquid fuel to the wick. It is also possible to locate the wick, 3, in an off-center location, for esthetic effect or for increased efficiency, dependent upon the shape and dimensions chosen for the melting plate, or to employ a plurality of wicks located at various positions within

the bowl. Raised portions, or lobes, may be present to define separate zones within such various shapes, and/or to facilitate heat conduction. For example, a clover shaped melting plate may be produced, having separate wicks and fuel elements containing a different coloring material in each of the leaves of the clover, with raised portions separating the zones, and each such zone configured to channel the liquified fuel to the wick located therein. Such a melting plate offers the opportunity for the consumer to choose among varying fuels, or to burn one, two, three, or more wicks at any given time.

A second example of a melting plate candle, 18, is shown in Figure 5, wherein a two piece construction is illustrated, also having a pool of fuel, 5, constituted of melted wax. In this design, the wick, 3, is proximate a heat lobe, 19, a raised portion of the melting plate, 2. The heat conductive element, or lobe, conducts heat to the rest of the melting plate, which is so shaped as to engage and/or partially rest upon the sides or slope of a non-conductive container, 26. The container may be made of any suitable material, such as glass, ceramic, plastic, wood, etc., and may be of any desired shape, the selection of such being determined, for example, by esthetics. The melting plate is configured in such a manner as to leave an insulating air gap, 27, between the melting plate and the container to limit heat transfer to the container, for safety, as well as to permit the greatest possible heat transfer from the melting plate to the pool of fuel, 5. As with the one piece construction melting plate of Figure 4, the melting plate may preferably be constructed of a stamped heat conductive metal. In this illustration, the wick, 3, is shown as being positioned within the central depression, 16, of the melting plate, proximate the lobes or heat conductive elements, 19, of the melting plate. The melting plate and lobes may also be designed to conduct the heat from the flame in a non-concentric pattern, allowing shapes other than round. Thus, by use of heat conducting lobes, constituting raised areas of the melting plate, melting plates may be oval, triangular, rectangular, or any other desired shape.

Exemplary of the various shapes which may be utilized is an oval heat plate candle, such as shown in Figures 6 and 7. Shown is a melting plate can-

dle, 18, comprising an oval non-conductive container, 26, in which is located a melting plate, 2, not shown, but present under the pool of liquified fuel, 5, said melting plate having raised lobes 19, in close proximity to a flame 1, centrally located. Arrows, 24, indicate the direction of conductive heat flow away from the flame via the melting plate, to enhance the melting of fuel, and heating of the pool of fuel located upon the surface of the melting plate. The melting plate is so configured as to cause the flow of liquified or melted fuel to the base of the wick, whereby it is consumed in the flame.

As previously stated, the heat conductive elements, such as lobes, may be so configured as to aid in location of the solid fuel element, particularly for location of solid fuel refill elements, as shown in Figures 8, and 9. As shown in Figure 8, a non-conductive container, 26, was provided, which held a melting plate, 2, in the manner shown in Figure 5, in juxtaposition to heat conductive lobes, 19. The lobes, as illustrated, were so configured as to act as a positioning device for a solid fuel refill element, 21, having wick 3. The lobes were situated upon a heating plate, 2, having a recess therein (not shown) into which the refill element was inserted so as to provide close proximity of the flame, 1, on the wick, 3, to lobes 19. As illustrated, the lobes provide two recesses for positioning of refill elements, although only one refill element is shown. The heat from the flame was transmitted to the solid fuel both by radiation, and by conduction through lobes 19 and the melting plate, 2, to rapidly melt the fuel, creating a pool of liquid fuel, 5. In this embodiment, the refill element comprised a cylindrical wax body similar to a votive candle, with a conventional wick. Other shapes of refill elements, such as balls, were added to the heating plate after consumption of the original fuel element. The convex shape of the melting plate assisted in both locating the refill elements and in assuring flow of melted fuel to the base of the wick, and the wick was retained in position by the wick clip of the candle element in the recess. Additional fuel refill elements were also found to be readily melted by the melting plate candle shown. Refill elements in the shape of discs, cubes, balls, pucks, and various other three dimensional shapes were also used. This configuration was also found to permit easy change of any active materials

desirably dispersed, by virtue of the second position for placement of a refill element, whereby refill elements having differing active ingredients could easily be alternated, just as refill elements of differing color could be alternated.

Another form of solid fuel candle which may employ the melting plate and heat fin technology of this invention is the floating melting plate candle. Conventional floating candles are known to tunnel very rapidly and to leave a high percentage of unburned wax, due to the cooling effect of the water upon which they float. A floating melting plate was tested, with an insulating air gap, in conjunction with a heat fin assembly holding the wick, which insulated the wax from the body of water upon which the melting plate floated, while heating of the wax was improved, so as to maintain a liquid wax pool for more uniform and more complete consumption of the fuel. As shown in Figure 9, a container, 26, retained a body of water, 30, upon which floated a melting plate candle, 18. The melting plate candle comprised a bowl shaped container, 20, having a melting plate, 2, seated therein, so as to form an insulating air gap, 27. The melting plate had a central depression, 16, into which was placed a wax fuel element, 21, comprising a heat conductive wick holder, 7, with a heat fin 11, and a retained wick, 3. The wax fuel element, 21, fitted around the wick holder, in close proximity thereto, whereby heat was transferred efficiently from the flame, 1, at wick 3, by the heat fin assembly to the melting plate, which thus improved melting of the wax, thereby forming a pool of liquid fuel. The outside container, 26, represents any suitable container for retention of a pool of water, or other liquid of choice, sufficient for floating a melting plate candle, such as a bath tub, sink, bowl, or pool. The melting plate container, 20, may be made of any suitable material, such as glass, ceramic, plastic, wood, etc, and may be of any desired shape, the selection of such being determined, for example, by esthetics, provided that the container be able to float safely on water while a heated fuel is disposed therein. The solid fuel segment may be of any shape, color, configuration, or composition consistent with the present invention, designed to properly fit the melting plate configuration. Examples of suitable refill segments would include circular, star, clover, or flower bud or petal shapes, or any three dimensional form selected, in

red, white, yellow, blue, green, or other colors, either plain or fragrancd by various perfumes, or containing various other active ingredients which will volatilize at the temperature of the liquid fuel pool formed in the bowl of the melting plate. In a conventional form of floating candle, a wax candle of low density is provided  
5 in a desired shape, configuration, and color, much in the fashion of the candle refill segments described above. In such candles, the wick is normally affixed with a conventional wick clip, and passes through the central portion of the wax body. Such candles, when floated in a body of water, suffer from short burning life, cratering, and drowning. Applicants have found that the use of a heat conductive wick holder, heat fins, and melting plate as illustrated in Figure 9, provided a floating candle which burned until all of the fuel therein was consumed.  
10 The shape of such floating melting plate candles may be of almost any configuration desired, with the wick holder being located centrally, or otherwise, and either single or plural. Shaping of the fuel element to any configuration is possible, as is the use of coloration for decorative purposes, along with a wide choice of  
15 actives, such as fragrances, to be included.

Similarly, when using solid fuel, such as wax, in conjunction with a heat fin or wick holder, solid fuel refill units may be shaped to fit the shape of the container, configured to fit the shape of the melting plate, in a "lock and key" relationship. For example, the melting plate may be a decoratively shaped container,  
20 and wax may be provided in the form of refills for the container shape selected, such as a round, square, star, clover, triangle, or other three dimensional shape, so shaped as to fit around and engage a complementarily shaped lobe or heat fin, for example.

25 The use of a melting plate with additional heat conductive elements offers a number of distinct advantages. First, it permits a larger pool of liquid fuel, due to improved heat conduction into the fuel, which results in more rapid formation of the pool. This in turn allows better regulation of the size and temperature of the liquified wax pool to allow more efficient use of fuels present. In fact, melting  
30 plates permit ease of refill, with little or no cleaning. The use of lobes in the heat plate in conjunction with heat fins in the fuel element also reduces or eliminates

retention of solidified excess fuel when the candle is allowed to burn itself out, and permits more complete and uniform burning of fuel elements which are other than round, i.e. square, oval, triangular, or in the shape of a flower or decorative object, etc. Further, the melting plate technology results in devices which may be self extinguishing, and improvements in or elimination of typical burning problems encountered with candles, such as tunneling, drowning, collapsing, cratering, and wick drift. Candles utilizing the melting plate technology of the present invention are also more forgiving of formulation or process variances.

## EXAMPLES

A number of tea lights were prepared to test the efficiency of the invention relative to heat distribution and melting of the wax fuel. In the following Examples, all candles comprised the same wax, and were of the same dimension, with identical consumable wicks. Examples comprised tea lights with conventional wick clips in a conventional aluminum container, tea lights with conventional wick clips but no container, and tea lights with a finned wick clip and heat plate as set forth in the present invention. Temperatures of the wax pool were measured at distances of 10 and 20 mm from the wick, using infrared temperature measuring methods.



Table 1

| Time vs. Temperature (° F) 10 mm from wick |                                   |                              |                           |
|--|-----------------------------------|------------------------------|---------------------------|
| Minutes                                    | Regular clip<br>Regular container | Regular clip<br>No container | Finned Clip<br>Heat Plate |
| 10   | 148                               | 147                          | 115                       |
| 15   | 147                               | 142                          | 121                       |
| 20   | 144                               | 137                          | 128                       |
| 25   | 142                               | 139                          | 136                       |
| 30   | 141                               | 137                          | 144                       |
| 40   | 144                               | 139                          | 128                       |
| 50   | 146                               | 138                          | 146                       |
| 60   | 154                               | 141                          | 177                       |
| 70   | 168                               | 138                          | 203                       |
| 80   | 170                               | 143                          | 208                       |
| 90   | 172                               | 142                          | 200                       |
| 120  | 171                               | 143                          | 172                       |
| 150  | 158                               |                              |                           |

In this experiment, the regular clip / regular container tea light burned out after 152 minutes, the regular clip / no container tea light burned out after 123 minutes, and the finned clip tea light burned out after 125 minutes. It may be seen that the tea light employing the finned clip achieved a much higher temperature in the wax pool than either of the other tea lights, exceeding a temperature of about 180° F at a distance of about 10 mm from the wick.

Table 2

| Time vs. Temperature (° F) 20 mm from wick |                                   |                              |                           |
|--|-----------------------------------|------------------------------|---------------------------|
| Minutes                                    | Regular clip<br>Regular container | Regular clip<br>No container | Finned Clip<br>Heat Plate |
| 10   | 78                                | 80                           | 79                        |
| 15   | 80                                | 138                          | 83                        |
| 20   | 80                                | 118                          | 87                        |
| 25   | 82                                | 107                          | 89                        |
| 30   | 85                                | 113                          | 91                        |
| 40   | 88                                | 119                          | 93                        |
| 50   | 89                                | 128                          | 130                       |
| 60   | 93                                | 127                          | 165                       |
| 70   | 97                                | 136                          | 172                       |
| 80   | 99                                | 139                          | 174                       |
| 90   | 102                               | 137                          | 167                       |
| 120  | 108                               | 119                          | 135                       |
| 150  | 117                               |                              |                           |

In this experiment, the regular clip / regular container tea light burned out after 152 minutes, the regular clip / no container tea light burned out after 123 minutes, and the finned clip tea light burned out after 125 minutes. It may be seen that the tea light employing the finned clip achieved a much higher temperature in the wax pool than either of the other tea lights, exceeding a temperature of about 160° F at a point about 20 mm from said wick.

While the present invention has been described with respect to what are at present considered to be the preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments. To the contrary, the invention is intended to cover various modifications and equivalent arrangements within the spirit and scope of the appended claims. The scope of the

following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent formulations and functions.

### INDUSTRIAL APPLICABILITY

5

The melting plate and heat conductive element candles of the present invention can be used in connection with a large variety of solid fuels. The conductive materials of which the melting plate and heat fins may be constructed are commonly available, and the various configurations are readily produced. There is considerable interest for candles having extended burn times, and for refillable candles or solid fuel lamps.

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